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Bright half-cycle optical radiation from relativistic wavebreaking[1]

BO MIAO, ANDY GOERS, GEORGE HINE, LINUS FEDER, FATHOLAH SALEHI, JARED WAHLSTRAND, HOWARD MILCHBERG, Institute for Research in Electronics and Applied Physics, University of Maryland, College Park, MD 20742 — Wavebreaking injection of electrons into relativistic plasma wakes generated in near-critical density hydrogen plasmas by sub-terawatt laser pulses is observed to generate an extremely energetic and ultra-broadband radiation flash. The flash is coherent, with a bandwidth of $\Delta\lambda/\lambda \sim 0.7$ consistent with half-cycle optical emission of duration ~ 1 fs from violent unidirectional acceleration of electrons to light speed from rest over a distance much less than the radiated wavelength. We studied the temporal duration and coherence of the flash by interfering it in the frequency domain with a well-characterized Xe supercontinuum pulse. Fringes across the full flash spectrum were observed with high visibility, and the extracted flash spectral phase supports it being a nearly transform-limited pulse. To our knowledge, this is the first evidence of bright half-cycle optical emission.

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